

Approval Process for delivery of Frequency Restoration Reserves to Nordic TSOs

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Abstract

The purpose of this document is to describe the tests to be performed in connection with approval of a power plant/station or a group of power plants for delivery of automatic Frequency Restoration Reserves (automatic FRR) to the Nordic TSOs, in the interim phase 2013.

This document is a reference document for potential suppliers and the National project team implementing automatic FRR in the individual TSO's countries.

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1. Introduction

This document describes the test procedure for approval of a power plant/station or a group of power plants from a provider and thereby enabling the provider to bid in for automatic FRR capacity to TSO.

Power plants/stations or group of power plants that are approved will have an identifier and will be qualified within a band of maximum positive regulation and minimum negative regulation. Note that the provider will in their request for approval define these bands; see the form in Annex A.2.

This document refers to national documents that describe the communication systems and the required signals that need to be exchanged between reserve provider and TSO.

2. Requirements

2.1 Grid connection

The TSO will assess the grid connection for a power plant/station proposed by the provider and reserves the right to exclude the power plant/station from participation or reduce delivery of automatic FRR if, in TSO's view, operational considerations should require it. In this case TSO shall advise the provider in writing of the decision.

2.2 Validation of delivery

TSO is responsible for validation of a delivery from a power plant/generator based on the criteria defined in section 5.

In Norway the automatic FRR is expected to be delivered per generator and the approval is given per generator. However, if a combined delivery from one station in Norway should be proposed by the provider (where several generators are delivering simultaneously), Statnett may require additional technical information to assist its analysis.

In Sweden, Denmark and Finland the requirements are portfolio requirements, which means that TSOs must have information on which power plants are included in the automatic FRR activation.

The approval tests in Sweden, Denmark and Finland will have to be made between provider and local TSO or when activation signals come from Statnett through local TSO.

2.3 Communications requirements

The provider must document that they fulfil the communication criteria defined by their national TSO before commencement of the prequalification tests.

Failure to provide the required communication arrangements could result in disqualification of the power plant/station/group of generators/provider.

2.4 Signals and measurements

The approval tests require operable communication with the provider's Automatic Generation Control (AGC unit) with all signals defined by their national TSOs. The accuracy of the measurements is specified in Annex A.1.

All signals used in the test shall be logged by both TSO and the provider.

2.5 Mix of generators

The mix of generators used in the prequalification should be documented by the provider as required in Annex A.2.

The provider can use a different mix of generators within the station/area as long as the response is in line with the product specification and the successful approval of the mix of generators used for operational delivery of automatic FRR. Several combinations of the same generators can be requested for approval. In any event the provider will be held responsible for delivering the required response once capacity has been purchased.

2.6 AGC tuning

Prior to provider requesting prequalification, the AGC must have been tested in accordance with the test requirements for the prequalification tests and tuned such that the station/provider meets the technical requirements defined in section 5.

The results of these tests shall be provided to TSO together with the application form in Annex A.2.

2.7 Other requirements

The provider shall disable Frequency Containment Reserves in the station during the approval test.

3. Request for technical automatic FRR installation test

3.1 Request from providers

The provider shall complete the form in Annex A.2 and send this to TSO no later than a week prior to the requested prequalification time.

TSO shall confirm within a week the exact time of the approval test.

3.2 Other documentation from providers

Verification of communication solution and results from provider tuning are to be provided to the TSO contact no later than one week before the approval test.

3.3 Timing

TSO can cancel the approval test at one hour's notice, should the operational situation require so.

TSO can request the test to be carried out outside normal office hours.

4. Test procedure

4.1 Signal test

This test aims to verify that all automatic FRR signals are correct and that they are transferred as expected.

Frequency Restoration Reserves response needs to be disabled during tests.

The test will be performed by manually updating the signals and then verify by phone (or other means) that the correct value is set with the other party. In the interim phase of the implementation of automatic FRR in 2013, 5 MW steps will be used for hydro generation. Providers that are to receive the continuous automatic FRR reference signal will also be excited by a stepwise reference during the response test, but in these cases the step size will be related to the characteristics of the automatic FRR bid from the provider/power plant concerned.

Part 1: Signals from TSO to the provider		
Automatic FRR set-point	Change the set-point: 0; 5; -5; 0	Read back values for every change
Automatic FRR enabled	Turn the signal ON Turn the signal OFF	Read back indication for every change
Part 2: Signals from the provider to TSO		
Actual Automatic FRR contribution Current Automatic FRR reserves UP Current Automatic FRR reserves DOWN	Change all three signals: 0; 5; -5	Read back values for every change
Remote control permitted Actual Automatic FRR contribution Current Automatic FRR reserves UP Current Automatic FRR reserves DOWN Unit in limitation UP Unit in limitation DOWN Dynamic limitation signal Regulation failure alarm PFK ¹ alarm	Turn the signals ON Turn the signals OFF	Read back indications for every change

¹ A dedicated alarm from the provider who has got a system protection trip signal from a TSO sub system. The provider has strict orders from the TSO and cannot provide automatic FRR.

4.2 Response test

This test will be conducted by sending a predefined sequence of set-points to the automatic FRR unit. The sequence will excite the maximum (ΔP Max) and minimum (ΔP Min) regulation that the automatic FRR unit wishes to be qualified for.

For thermal power plants that are to receive the continuous reference, the test ΔP is found by the ramp rate in 100 sec.. For thermal power plants the automatic FRR response is evaluated on the basis of its ramp rate and the PT4 characteristics.

4.2.1 Test sequence for (hydro) units that are to receive a step signal

If the grid situation requires so, the test might be conducted with lower maximum excitation. If capacity is less than 10 MW, only the first 25 minutes of the test apply.

As long as the desired test regulating margin is symmetric, the test will be energy neutral, meaning that the test will regulate down as much as up, and if the test is made within the same hour the imbalance cost will be zero.

The sequence will be as follows for hydro units:

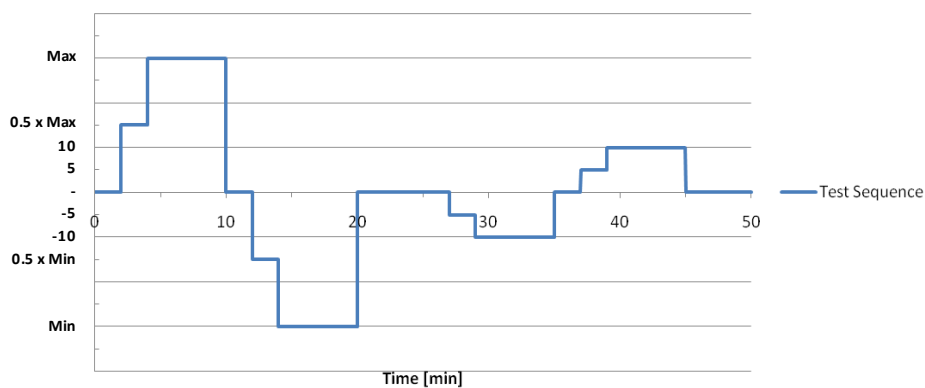


Figure 1: Test sequence for hydro units.

- In table form:

Time [min]	Set-Point [MW]
0	0
2	50% ΔP_{max}
4	ΔP_{max}
10	0
12	50% ΔP_{min}
14	ΔP_{min}
20	0
27	-5
29	-10
35	0
37	5
39	10
45	0

4.2.2 Test sequence for (thermal) units that are to receive the continuous reference

The response test sequence for thermal units will have the following characteristics:

- Minimum 15 min without set point change;
- Set point step upwards (or downwards): Maximum of ramp rate [MW/sec * 100 sec] but minimum 1% of nominal power;
- After at least 20 minutes a step in same size in the other direction;
- At least 20 min before new set point changes again.

The measured response shall be within the envelope that is specified in Figure 3. The test can be repeated if the normal firing fluctuations give many peaks outside the acceptance requirements. An average of more tests can be used as the acceptance test. The value of the power change to set point change will be taken as average of the change in power in the period 15 to 20 minutes after the set point change.

Supplementary the ramp rate has to be documented as a power curve where the unit goes from minimum to maximum and the other direction. This power curve can be shown from more periods, (using normal operation periods during ramping).

4.3 Loss of communication test

In addition to testing the desired response, we will test that the AGC responds properly to a simulated short loss of communication. A proper response is defined as keeping the existing set point until further instruction.

5. Assessment

This section will include the assessment of the requirements described in sections 3 and 4. An Excel sheet will be provided as fill-in form. Annex A.4 shows the Approval document.

5.1 Technical description

The request for prequalification (see Annex A.3) is filled out properly, and all technical parameters are in line with the requirements.

5.2 AGC testing

The provider has shown sufficient documentation that the AGC is tuned and tested so that it is ready for prequalification.

5.3 Communication

The provider has shown sufficient documentation that the communication interface is in place.

5.4 Accuracy

The accuracy of an automatic FRR unit is defined in terms of how accurately it responds to a change of the set-point. The change of generated power should be no more than 10% different from the change in TSO set-point; i.e.: If the set-point changes from 20 to 30 MW, the increase of the total generation of the generators should be between 9 and 11 MW. The figure below shows the envelope for the required hydro response and for the required response of a thermal unit that responds like PT4 with a time constant of 35 sec.

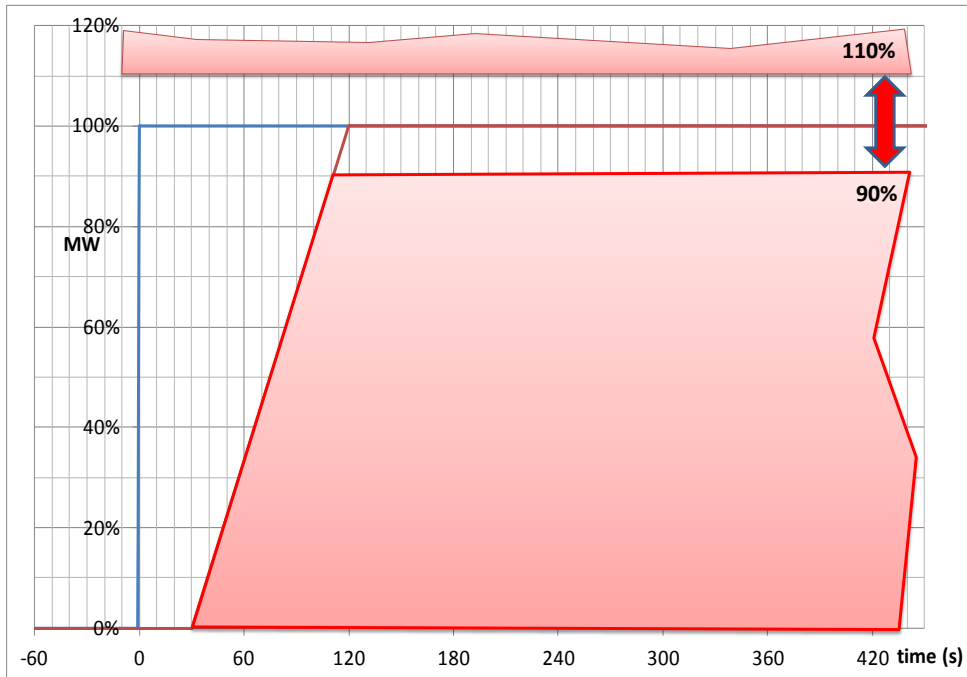


Figure 2: Envelope for the required response of a hydro unit to a step change of the set-point.

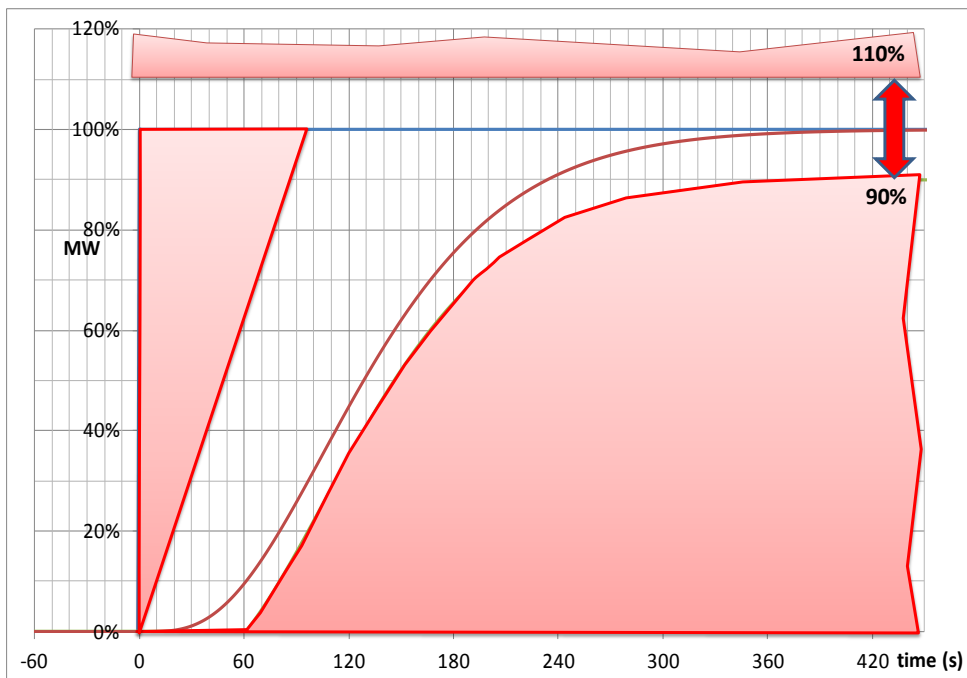


Figure 3: Envelope for the required response to a step change of the set-point of a thermal unit that responds like PT4 with a time constant of 35s.

In addition, the total sustained error should be no more than 5 MW; i.e.: If the set-point is 80 MW, the generation of the participating generators should be

between 75 and 85 MW higher than their planned values (after adjusting for primary regulation).

During the prequalification, TSO reserves the right to approve an automatic FRR unit with a larger accuracy error, should this operationally be preferable, if the provider works to meet the required accuracy within a reasonable time frame.

5.5 Delivery time

The time from the signal is sent from TSO till the generation has reached its target value is the delivery time.

The total delivery time in the test is in accordance with the figures in section 5.4.

5.6 Generation ramping for thermal power plants

The ramp rate required in the test is in accordance with the minimum requirements specified in section 4.2.2.

For thermal power plants the ramp rate must be documented as a function of boiler load. This documentation shall be part of the documentation sent in together with the request for approval; see Annex A.2.

5.7 Response delay (hydro)

The time from the signal is sent from TSO till the generator has started to regulate is denominated 'the response delay time'.

The response delay time is max 30 sec., in accordance with Figure 2 in section 5.4.

6. Approval

6.1 Automatic FRR unit approval

An automatic FRR unit is deemed to be approved if it fulfils the requirements described in section 5.

6.2 Validity

The prequalification is valid for a period of 5 years, after which time a new prequalification can be required, or until significant changes in automatic FRR requirements will be implemented.

Should the provider modify the AGC or generator regulator or the communication interface, a prequalification will be required.

All such changes should be advised to TSO within one month before commencement, and TSO shall then decide whether the automatic FRR unit will be accepted for further delivery.

Annex A

A.1 Requirements for measurements of TSO and Reserve Provider

The provider is required to provide high resolution (MW resolution: 0.1 MW; time resolution preferably 1 second, but not more than 10 second) measurements of the generators' responses which are part or the whole of the automatic FRR approval test. Also, the local frequency measurement (resolution 1 mHz) should be logged with the same resolution.

The measurement resolution should be low for the test. No more than 0.5 MW or 1% of nominal full-load power (0.1 MW for a 10 MW generator).

A.2 Request for approval of automatic FRR capacity

This form should be filled out when applying for the prequalification test. It can be found as an Excel sheet together with Approval document at the TSOs' homepages.

Balance responsible:	Station Group:				Station:
Administrative contact person					
Name:	Mob:		Email:		
Technical contact person					
Name:	Mob:		Email:		
Desired test date:					
Desired regulating volume:	Up [MW] :				
	Down [MW] :				
Desired ramp rate:	Up [MW/min]				
	Down [MW/min]				
Generators:	List names of all generators that could be part of the FRR Capacity. Specify in percentage which generators that are to be used in the test				
Gen 1	% in test	Gen 2	% in test	Gen 3	% in test
Gen 4	% in test	Gen 5	% in test	Gen 6	% in test
Any reservations from the grid investigation?	Yes		If 'Yes', specify		
	No				
Attached documents:					
Other comments:					

Figure 4: Request for approval to be sent to local TSO before prequalification test.

A.3 Test documentation

Before undergoing the tests, the provider should provide documentation that the AGC can comply with the requirements.

The documentation should include measurements of the response to a step of the set-point of the automatic FRR and must show a response that is in accordance with the requirements in section 5.

Balance responsible:	Station Group:	Station:	Price area:

Chapter	Requirement fulfilled		Comment
	Yes ()	No ()	
5.1 Technical description			
5.2 AGC Testing			
5.3 Communication			
5.4 Accuracy			
5.5 Delivery time			
5.6 Generation Ramping			
5.7 Response delay			
2.1 Grid connection			

Test date and time:	
Test person from provider:	
Test person from local TSO:	
Test person from Statnett:	

Figure 5: Test document to be filled out during the test.

A.4 Approval document

Approval document is a document accepting the participation of the tested provider/generator/group of generators/power plant with attached documents that has relations to each approval.

These documents will be individual from TSO to provider.